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# Summary of: The Impact of Macroeconomic Conditions on the Instability and Long-Run Inequality of Workers' Earnings in Canada

by Charles M. Beach, Ross Finnie and David Gray

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## *I. Introduction*

In the 1980s and 1990s, Canada's labour market was influenced by increasing integration with the U.S. economy, the rapid advance of information technology, 'out-sourcing' and non-standard work patterns, fluctuating natural resource prices, increased competition and worker vulnerability, and high immigration. On a macroeconomic level, the economy recovered slowly from the recession of the early 1990s. Some of these developments might be expected to have an impact on the distribution of labour market earnings across workers. Indeed, strictly cross-sectional analyses have shown that earnings inequality increased significantly in Canada in the 1990s.[1]

Understanding the patterns of earnings instability and long-run earnings differences is of economic and policy interest. Increased earnings instability over time, stemming from out-sourcing, industry and workplace restructuring, greater use of contingent and non-standard employment arrangements, declining private-sector unionization rates, volatile primary good prices, or changing occupational demand, indicates an increase in worker vulnerability, as examined by Chaykowski (2005), and in economic insecurity, as discussed by Osberg (1998) and measured by Osberg and Sharpe (2002), and a policy focus on social insurance and capital market imperfections. Increased variability in long-run earnings differentials across workers is related to lifetime earnings patterns, which is closely associated with long-run earnings inequality. This is affected by human capital attainment, long-run labour force participation and work patterns, evolving industry/occupational mix in the economy, and shifting returns to skills and cohort effects that speak to a largely different set of policy issues involving skill, matching, and access to training and efficient usage of such human capital.

This paper builds on our previous work (Beach, Finnie and Gray, 2003), which presented how overall earnings variation showed a structural shift over the 1990s compared to the 1980s. Applying a variance decomposition approach (Gottschalk and Moffitt, 1994) to the Longitudinal Administrative Database (LAD), the present paper examines the variability of workers' earnings in Canada over the 1982–1997 period, showing how earnings variability varied in terms of the unemployment rate and the real gross domestic product (GDP) growth rate; it provides benchmark results on the earnings variability experience of women as well as men, for a broader sample of labour market participants than is regularly employed.

## *II. The data file and the estimation samples*

The data set is Statistics Canada's Longitudinal Administrative Database (LAD) file—a 10% representative sample of all Canadian income tax filers, containing over 1.5 million records per year. The measure of earnings is total annual wage and salary income (henceforth "earnings") as reported on individuals' tax forms. The estimation samples include all paid workers age 20–64 who were not full-time students during the tax year, who received at least $1,000 (in 1997 constant dollars) of earnings, whose earnings exceeded any net self-employment income, and who reported at least two years of above-minimum earnings.

1. For evidence based on various data sets, a non-exhaustive list of references includes Beach and Slotsve (1996), Burbidge, Magee, and Robb (1997), Heisz *et al.* (2002), Picot (1997), Richardson (1997), and Wolfson and Murphy (1998).

To compare the two decades, we identify two estimation samples: 1982–1989 and 1990–1997. A Broad Estimation Sample (BES) includes any worker-year record that satisfies the inclusion criteria that $2<T_i<8$, where $T_i$ indicates the number of years during which worker i was in the sample during the sub-period. In a Narrow Estimation Sample (NES), a sub-sample of the BES, persons report above-minimum earnings in *each year* of the relevant sub-period. So there are four separate estimation samples for each gender: BES and NES for 1982–1989 and 1990–1997. The estimation samples involve breakdowns by age: 'Entry' (20–24 years), 'Younger' (25–34 years), 'Prime' (25–54 years), and 'Older' (55–64 years). This allows us to examine separate earnings variability patterns over different phases of the life-cycle.

The two sub-periods have similar business coverage.[2] The first, 1982–1989, begins at the end of the 1980–1982 recession and includes the subsequent expansion; the second, 1990–1997, includes the 1990–1992 recession and the following growth period.

There are major differences in earnings outcomes between the BES and the NES samples (Beach, Finnie and Gray, 2003). The BES median earnings levels are noticeably lower than the NES figures, and the ratio of the BES median earnings to NES earnings declined between 1982 and 1997. For both genders, earnings inequality is much greater in the BES than the NES samples. The BES results also show a sizeable increase in earnings inequality, especially for men, in contrast to a slight decrease for the NES.

### *III. Variance components by region and time period*

Decomposition is carried out for each age/sex group, time period, and region. In the results by age and sex (Beach, Finnie and Gray, 2003), the breakdown in the total variation is approximately one-third for the transitory component and two-thirds for the permanent component. The significant rise in earnings variability for men is driven primarily by the permanent component; a secondary factor is the increased volatility of workers' earnings about their life-cycle earnings profiles. For women, this latter effect is small, even working to reduce overall earnings variability in some age groups.

As these results are based on *longitudinal* data, the three variance terms differ from conventional inequality or dispersion estimates calculated from cross-sectional data. The latter incorporates long-run earnings differences related to skill levels and work activity across workers, and to transitory differences associated with short-run fluctuations in earnings, at a given point in time,

---

2. The two intervals over which our variances are calculated both span 8 years, and exhaust the entire LAD sample until 1997. They do not, however, reflect identical phases of the business cycle. Given that the macroeconomic conditions were somewhat different during the two time periods, it is possible that the trend effect we attempt to discern between time periods may be confounded with business cycle effects. To address this, we examined the robustness of our calculations of the variances to a change in the time intervals. The buffer years of 1989 and 1990 were omitted, so that the two time periods become 1982–1988 and 1991–1997. This omission generates two intervals each spanning 7 years. Both time periods commence near the trough of a business cycle and end six years into an expansion phase. The resulting changes in earnings variability between the earlier and the later periods (expressed in percentage terms) are slightly larger in the shortened intervals compared to the full intervals of 1982–1989 and 1990–1997. Nevertheless, the signs and the relative magnitudes of the changes over time are quite robust to the change in intervals over which the variance components are calculated. This pattern is consistent with the conjecture that there is a secular trend of increasing earnings variance over time. As the gap between time periods widens (from no gap between adjacent intervals of 1982–1989 and 1990–1997 to a hiatus of 2 years), the contrast between their measures of dispersion is enhanced, suggesting that the business cycle phase is not driving our primary results.

and the total variance calculated from longitudinal data also incorporates both components, and is the measure most comparable to cross-sectional estimates. However, we use longitudinal data to break out the components. The transitory variance picks up year-to-year deviations in earnings about a life-cycle earnings trajectory and hence estimates earnings *instability*. The permanent variance picks up differences across workers in the average height of their life-cycle earnings trajectories and provides an estimate of *long-run inequality* of earnings.

All three variance terms are higher in the BES sample than in the NES one, as the BES includes workers with relatively low and unstable earnings patterns. But the relative importance of the permanent and transitory components is similar: about two-thirds for the former and one-third for the latter. Variance terms are generally larger for women, but the relative importance of the two variance components remains similar for both genders.

Results indicate that overall earnings variability increased between 1982–1989 and 1990–1997, and the increase was largely confined to men. The greater part of the increase (especially for men) was driven by widening long-run earnings inequality. For men, increased instability of earnings played a secondary role in the overall earnings variance increase; for women, earnings instability decreased substantially, and long-run inequality widened, though only about half as much as for men. As a result, the gap in earnings variances between women and men noticeably declined over this period.

Regional differences are also apparent. Overall earnings variance is the highest in the Atlantic region, followed by Quebec and Alberta (and British Columbia in the BES sample); it is lowest in Manitoba-Saskatchewan and Ontario (for some sub-samples). Long-run earnings inequality is most important in Atlantic Canada, and least so in British Columbia, Ontario and Alberta. Increases in earnings variability among men were greatest in Ontario and Quebec, which experienced severe recessions in the early 1990s and whose manufacturing base experienced substantial restructuring and changing trade patterns. Again, increases in long-run earnings inequality drove the results.

## *IV. Net effects of time shift, age and region*

We categorize the estimating samples into age/sex groups crossed with geographical region to generate a finer breakdown to which multivariate regression can be applied. As there are four age groups for each time period within each of the six regions, 48 cells are generated. In both genders, and in both the BES and the NES samples, the Atlantic provinces show a significantly higher net earnings variance (relative to Ontario), with smaller net positive effects for British Columbia and Alberta, and slight negative effects for Manitoba and Saskatchewan.

Total earnings variance varies with age, more significantly so for men, with the youngest and oldest workers experiencing the highest variances. Among women, total earnings variance generally increases with age, but the differences are generally smaller than those for men. The permanent variance component tends to increase with age, as earnings differentials generally widen over the life cycle, but the earnings instability component tends to decline with age, since job mobility decreases as workers get older, with the exception of older men.

## *V. Macroeconomic effects on earnings inequality and instability*

In the next set of regressions, 12 equations are estimated consisting of 3 dependent variables (one for each variance measure) for 4 samples (male BES, male NES, female BES, female NES). The provincial binary variables are replaced by variables reflecting the macroeconomic conditions in each region during each interval: the average unemployment rate, and the rate of real GDP growth. For Canada as a whole, real GDP increased by 31.7% over 1982–1989 and 15.8% over 1990–1997. Ontario had the highest growth rate in the first period (41.0%[3]), Alberta in the second (32.8%). Manitoba and Saskatchewan had the slowest growth in the first period (20.9%), the Atlantic region in the second (9.2%). Ontario led in employment growth over 1982–1989 at 23.6%, but fell to 2.4% over 1990–1997. Quebec was similar, at 18.3% and 1.7%, respectively, but British Columbia experienced employment growth of 20.5% in the first period and 20.2% in the second. While unemployment rates remained high in both periods in Atlantic Canada and Quebec, they rose from averages of 7.5% to 9.1% between periods in Ontario, but declined from 9.3% to 7.9% in Alberta, and from 12.4% to 9.1% in B.C.

## *VI. Regression results with macroeconomic indicators*

In the results for the regression equations, including the average unemployment rate and the real GDP growth rate, the age and time-shift effects are similar to those already discussed. For continuous variables such as the macroeconomic indicators, sensitivity is often better represented by elasticities, as presented in Table 1. All three variance measures are more sensitive to fluctuations in the unemployment rate than to changes in the GDP growth rate. This shows up more for men than for women, which is consistent with men being more concentrated in the cyclically sensitive primary, manufacturing, and transportation/construction sectors. The macroeconomic effects on transitory earnings variance or earnings instability occur as expected from conventional labour market arguments. Good economic times are associated with more stable employment patterns, so that earnings instability is reduced; more for men than for women and more within the BES sample, which includes more irregular or intermittent workers. Reduced unemployment rates and thus tighter labour markets also reduce earnings instability, again more for men than for women because of the generally more cyclical nature of the sectors in which men are more concentrated. But this effect is stronger in the more homogeneous NES sample than in the BES sample. This suggests that workplace restructuring during the early 1990s recession applied at least as much to higher-wage jobs of workers fully attached to the labour market as to relatively low-wage jobs and those only intermittently attached to the labour market.

3. All figures from Statistics Canada (2003): 105, 109.

**Table 1: Elasticities for unemployment rates and real GDP growth rates**

| | Men | | | Women | | |
|---|---|---|---|---|---|---|
| | Total variance | Transitory variance | Permanent variance | Total variance | Transitory variance | Permanent variance |
| **Broad Estimation Sample (BES)** | | | | | | |
| UR | 0.1195* | 0.1714* | 0.0437 | 0 .1179** | 0.0382 | 0.1192** |
| GR | 0.0159 | -0.0440** | 0.0386** | 0.0262** | -0.0303* | 0.0468** |
| **Narrow Estimation Sample (NES)** | | | | | | |
| UR | 0.3221** | 0.3092** | 0.3464** | 0.2420** | 0.1009 | 0.3067** |
| GR | 0.0451** | -0.0258 | 0.0766** | 0.0550** | -0.0212 | 0.0878** |

Note: ** (*) denotes statistical significance at the 1% (5%) level. UR is an abbreviation for the unemployment rate, and GR is the measure for real growth in GDP.

Gross results and conventional economic theory suggest that in periods of prosperity and economic expansion, wage differentials narrow and low-skilled lower-wage workers disproportionately benefit from tighter labour markets. Thus, earnings inequality should attenuate. On the other hand, in periods of slow growth and economic recession the opposite should happen. These effects should be stronger in the more heterogeneous BES sample than in the NES. And in fact, slower growth over the 1990–1997 period is associated with increases in both permanent and total variance measures. But in Table 1, we observe *positive* effects of GDP growth on permanent variance or long-run inequality across workers and on total variance; these effects are substantially larger in the NES than the BES samples and slightly larger for women than men; all four effects are individually highly statistically significant.

Two explanations of the growing inequality in earnings are: 1) globalization, out-sourcing, and international trade; and 2) skill-biased technological change. These "I.T." hypotheses (Katz and Autor, 1999; Beach, 2004) may affect economic restructuring and workplace reorganization. If such restructuring occurs more in the high-growth and manufacturing-oriented regions of the country, this would explain the widening degree of earnings inequality associated with more high-growth regions, and the positive coefficients of GR on permanent variance in Table 1, as well as why the effects are operating more strongly in the NES sample workplaces than the BES. Adjustment to the "new economy" may happen faster in the high-growth and manufacturing-oriented provinces. If so, this calls for a general re-examination of the arguments for macroeconomic effects on earnings inequality.

## *VII. Simulation exercise of an economic recovery*

There is a strong positive correlation between growth in real GDP and labour market tightness. It makes sense, therefore, to examine the unemployment rate and the GDP growth rate effects *jointly* through a simulation exercise incorporating the above macroeconomic effects. Our scenario uses economic recovery conditions characterized by a one standard deviation increase in the real GDP growth rate (+0.32) combined with a one standard deviation reduction in the unemployment rate (-2.4). The latter effect reduces all variance components; the former has opposing effects on the long-run inequality and the earnings instability components. For the signs of the effects of the percentage changes in the variance components, see Table 2.

**Table 2: Macroeconomic prosperity effects on earnings: Total variance and components**

| Sub-sample | Variance component | Independent effect of unemployment rate | Independent effect of real GDP growth | Joint effect of macro prosperity | Total effect of macro prosperity on total variation |
|---|---|---|---|---|---|
| NES males | permanent | positive | positive | negative | negative |
| | transitory | positive | negative | negative | |
| BES males | permanent | positive | positive | positive | negative |
| | transitory | positive | negative | negative | |
| NES females | permanent | positive | positive | positive | negative |
| | transitory | positive | negative | negative | |
| BES females | permanent | positive | positive | positive | negative |
| | transitory | positive | negative | negative | |

Except for NES men, the long-run inequality of earnings (the permanent component) increases with economic prosperity because of the dominance of the GDP growth effect. In contrast, the instability of earnings (the transitory component) is reduced with economic prosperity because of the strong unemployment rate effect combined with the negative growth effect on instability. The joint macroeconomic prosperity effect is stronger on the instability of earnings than on long-run inequality; this holds for both genders and both the NES and the BES samples. And given a climate of macroeconomic prosperity, the reduction in earnings instability dominates the increase in long-run inequality of earnings, generating a net reduction of total variance with greater economic prosperity, even though the share of the permanent component within the total variance is greater. Thus, favourable macroeconomic performance reduces the overall variation of earnings, despite the opposing effects on its two components; it also reduces the ratio of transitory to permanent variance and increases the ratio of permanent to total variance.

## *VIII. Conclusions*

Results indicate an increase in overall earnings variability between 1982–1989 and 1990–1997, largely confined to men. This increase was driven by widening long-run earnings inequality. Increased instability of workers' earnings played a secondary role in the overall increase in men's earnings variability; for women this change was small or, in some age groups, worked to reduce women's overall earnings variability. As a result, the gap in earnings variances between women and men has declined.

In addition, unemployment rates and real GDP growth rates have statistically significant effects on total earnings variability and its two components, with the unemployment rate having much stronger effects in terms of elasticities. The pattern of unemployment rate and GDP growth rate effects on earnings instability are consistent with conventional cyclical labour market arguments: unemployment and earnings instability increase in recessions and decrease in expansions. But the estimated growth rate effect on long-run earnings inequality does not fit conventional arguments, being associated with economic restructuring and workplace reorganization in response to changing trade patterns and information-based technological change.

Finally, when unemployment rate and GDP growth rate effects are considered jointly, macroeconomic improvement reduces the overall variability of earnings, as the reduction in earnings instability outweighs the general widening of long-run earnings inequality across workers.

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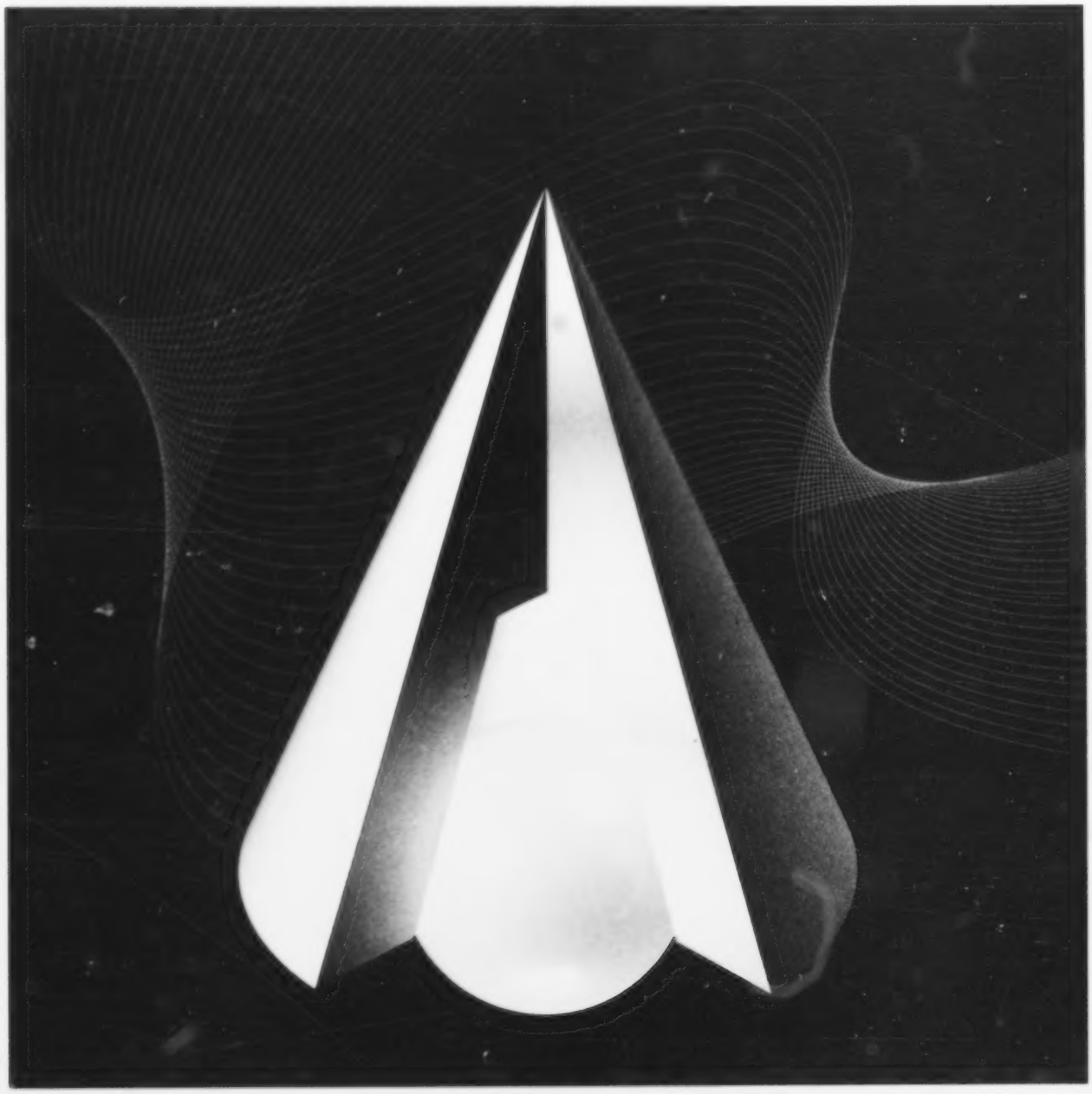

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## *Abstract*

This paper examines the variability of workers' earnings in Canada over the period 1982-1997 and how earnings variability has varied in terms of the unemployment rate and real gross domestic product (GDP) growth over this period. Using a large panel of tax file data, we decompose total variation in earnings across workers and time into a long-run inequality component between workers and an average earnings instability component over time for workers. The analysis is done for men and women and for both long-run participants and a broad coverage of workers. We find an increase in earnings variability between 1982–1989 and 1990–1997 that is largely confined to men and largely driven by widening long-run earnings inequality. Second, the pattern of unemployment rate and GDP growth rate effects on these variance components is not consistent with conventional explanations of cyclical effects on earnings inequality and is suggestive of an alternative paradigm of how economic growth over this period widens long-run earnings inequality. Third, when the unemployment rate and GDP growth rate effects are considered jointly, macroeconomic improvement is found to reduce the overall variability of earnings as the reduction in earnings instability outweighs the general widening of long-run earnings inequality.

**Keywords:** earnings mobility, earnings dynamics

## 1. Introduction

Canada's labour market in the 1980s and 1990s was subject to transformations such as increasing integration with the U.S. economy and shifting trade flows, the rapidly advancing state of information technology, shifting modes and organization of production such as 'out-sourcing' and non-standard work patterns, fluctuating prices for natural resources, increased competition and worker vulnerability, and high inflows of immigrants. On the macroeconomic level, the economy recovered slowly from the recession of the early 1990s, as the unemployment rate was persistently high until the late 1990s (for a useful overview, see Reid, Meltz and Gomez, 2005). Some of these developments might be expected to have an impact on the distribution of labour market earnings across workers. Indeed, strictly cross-sectional analyses have shown that earnings inequality increased significantly in Canada in the 1990s.[1]

This paper examines the variability of workers' earnings in Canada over the period 1982-1997 and how earnings variability has varied in terms of the macroeconomic indicators, the unemployment rate and the real GDP growth rate, over this period. Conventional explanations of cyclical effects on (cross-sectional) earnings inequality, based on evidence from the 1960s and 1970s, predict that inequality widens in periods of slow growth and recessions and narrows as economic growth increases and labour markets tighten. In light of the distinctive changes in the Canadian economy noted above over more recent decades, we reconsider these explanations with a novel data set and empirical methodology. The paper makes use of a large panel of income tax data over the 1982-1997 period and applies a variance decomposition methodology of the total variation in earnings among workers over this period into a systematic or permanent or long-run component between workers and a transitory or earnings instability component over time for workers. All three of these measures of earnings variability are then modelled as a function of the above macroeconomic indicators using multiple regression so that the net effects of these indicators can be separately examined then jointly simulated.

Conventional earnings variance modelling in the literature (in both Canada and the United States) has focused on modelling structural time-series processes determining earnings profiles with the goal of distinguishing between temporary and permanent variations.[2] But such structural modelling approaches require rectangular arrays of data for workers with high labour market attachment, and thus have been largely restricted to the analysis of prime-age male workers with long-run close attachment to the labour market. A secondary contribution of this paper is to expand our knowledge of benchmark results by providing empirical analysis for women as well as men in the labour market and for a broader sample of labour market participants beyond those with very stable employment histories as well as for a narrower sample of workers with continuously reported annual earnings.

Understanding the patterns of earnings instability and long-run earnings differences across workers is of economic and policy interest. Interpreting net (reduced-form) regression effects

1. For evidence based on various data sets, a non-exhaustive list of references includes Beach and Slotsve (1996), Burbidge, Magee and Robb (1997), Heisz *et al.* (2002), Picot (1997), Richardson (1997), and Wolfson and Murphy (1998).

2. Some earlier, well-known references from the U.S. literature are Abowd and Card (1989) and Lillard and Weiss (1979), while the counterparts for the Canadian literature are Baker (1997) and Baker and Solon (2003).

over the business cycle allows one to rethink how well conventional models explain such benchmark results and to offer alternative perspectives. A finding of increased earnings instability over time, stemming perhaps from factors such as out-sourcing, industry and workplace restructuring, greater use of contingent and non-standard employment arrangements, declining private-sector unionization rates, volatile primary good prices and changing occupational demand, would indicate an increase in worker vulnerability, as examined by Chaykowski (2005), and in economic insecurity, as discussed by Osberg (1998) and measured by Osberg and Sharpe (2002), and a focus on policy issues concerning social insurance and capital market imperfections. On the other hand, a finding of increased variability in long-run earnings differentials across workers is related to lifetime earnings patterns, which is closely associated with long-run earnings inequality. This is affected by factors such as human capital attainment, long-run labour force participation and work patterns, evolving industry/occupational mix in the economy, and shifting returns to skills and cohort effects that speak to a largely different set of policy issues involving skill, matching, and access to training and efficient usage of such human capital.

In terms of both scope and methodology, the current paper builds substantially on our previous work (Beach, Finnie and Gray 2003), which laid out the background for estimation of the variation in earnings and the decomposition process. There we presented a descriptive treatment of how overall earnings variation—as well as the breakdown into the two components—showed a structural shift measured over the 1980s (i.e., average values calculated over 1982-1989) compared to the 1990s (i.e., average values calculated over 1990-1997). The point of departure for the present paper involves an econometric analysis of the sensitivity of the variance components to the business cycle based on the indicators of the unemployment rate and the growth in real GDP. To this end, we add the dimension of geographical region to our empirical analysis.

The next section of this paper contains a brief survey of the relevant literature. We then set out the analytical framework and introduce the data set employed and outline the main characteristics of the estimation samples. The core regression analysis is then presented and the cyclical results interpreted. The major findings are reviewed and some implications considered in the concluding section.

## 2. *Survey of the literature*

Based on the U.S. Panel Study of Income Dynamics (PSID), Gottschalk and Moffitt (1994) found that both a growing instability of earnings and a widening dispersion of permanent earnings (of white male workers) contributed to the increasing degree of wage inequality which occurred between the late 1970s and the 1980s. Using a different methodology applied to a more recent version of the same data set, Haider (2001) found that earnings instability increased during the 1970s, and lifetime earnings variation increased substantially during the early 1980s among U.S. males. He determined that the persistent variation component is only mildly counter-cyclical, while earnings instability is strongly counter-cyclical. In a more recent study drawing from the PSID that employs a different methodology, Moffitt and Gottschalk (2002) discern a secular rise in the permanent component of earnings until 1997, and a rather dramatic increase in the transitory component during the 1980s, followed by a decline after 1991. Those authors suggest

that it would be useful to examine the relationship between the latter component and the business cycle, which we do in this present Canadian application.

The Canadian literature on earnings variability is somewhat sparse, largely due to an historical lack of longitudinal data that are required for analysis of earnings dynamics. Consequently, the only existing work is based on administrative data files.[3] Beach and Finnie (2004) examine year-to-year earnings mobility patterns and shifts in longitudinal earnings profiles over the period 1982-1999. Baker and Solon (2003) is the closest Canadian work to that undertaken in this paper. They employ data merged from the Canada Revenue Agency's (CRA's) (formerly Canada Customs and Revenue Agency (CCRA)) T1 tax forms (filed by individuals) and T-4 Supplementary Tax Files (submitted by employers) covering the period from 1976 to 1992, and include only male workers reporting positive earnings for at least nine consecutive years. Using a parametric econometric methodology, they estimate the covariance structure of the time series processes generating the earnings data, from which they derive point estimates of total earnings variation as well as permanent and transitory components.

Despite sharing a common theme of decomposition of the variation of earnings with Baker and Solon (2003), our objectives and methodology are different. The underlying statistical methodology that we employ is much simpler in its specification of inter-temporal earnings changes. Our data set is broader. Specifically, for part of our analysis, we only require workers to have at least two years of reported earnings over an eight-year interval in order to enter the estimating sample, thus including workers with weaker and less permanent attachment to the labour force. Our analysis also includes results for both men and women and we use a broader age coverage. Finally, our data set covers a later period, specifically 1982-1997.

## 3. Analytical framework

This paper adopts the methodology employed by Gottschalk and Moffitt (1994), which involves a variance decomposition procedure using longitudinal data. This methodology is descriptive in nature and is equivalent to a random-effects error-components model (see Johnston, 3rd Ed. (1984: 400)). It can be shown that the total variance of earnings in a panel equals the sum of the transitory variance (across time for workers) and the permanent variance (across workers), thus providing a convenient decomposition:

$$\text{Var}_{\text{Total}} = \text{Var}_{\text{Transitory}} + \text{Var}_{\text{Permanent}}$$

This identity is conditional on there being the same number of time series observations for all individuals in the sample (rectangular array of data). This simple descriptive technique is alternative to the covariance structure approach employed in Haider (2001), and Baker and Solon (2003) that seeks to model the parameters of the underlying earnings time-series process, and our approach does not seek to draw inferences regarding the stochastic structure of earnings. It does provide, however, an intuitive measurement and benchmark description of the variance components, which provide useful insight into what has been occurring to workers' earnings in terms of instability over time and long-run or permanent earnings inequality across workers, and

3. The Survey of Labour and Income Dynamics (SLID) is also another longitudinal database which has recently become available, but it has not been used as yet to address the issues covered in this paper. Its first cohorts date to 1993, and individuals are rotated out of the sample after 6 years.

which are linked by a tidy identity containing the "between component" of variation (i.e., across workers) and the "within component" of variation (i.e., within the life-cycle for a given worker). Some prior research has indicated that the two methodologies can yield similar qualitative results.[4] But the simpler methodology employed here can be applied to a broader range of samples and hence a broader coverage of workers in the labour market.

## 4. The data file and the estimation samples

The data set used in this paper is Statistics Canada's Longitudinal Administrative Database (LAD) file. It is a 10 % representative sample of all Canadian income tax filers drawn from CRA's T1 tax files, containing over 1.5 million records per year. The measure of earnings used in the paper is total annual wage and salary income (henceforth "earnings") as reported on individuals' tax forms.

The estimation samples used in this analysis include all paid workers aged 20 to 64 who were not full-time students during the tax year, who received at least $1,000 (in 1997 constant dollars) of wage and salary income, whose earnings exceeded any net (declared) self-employment income, and who reported at least two years of above-minimum earnings (as just defined) on the LAD file. These omissions are aimed at approximating Statistics Canada's concept of "All Paid Workers" while excluding those with only limited attachment to the labour market.[5] Further details regarding the data file, including the coverage of the LAD, and its degree of representativeness of the general population are contained in Beach, Finnie and Gray (2001).

In order to make comparisons between the two decades covered, we identify two separate estimation samples, one for each of the following two eight-year sub-periods: 1982-1989 and 1990-1997. The unit of observation is the person-year. We also identify a Broad Estimation Sample (hereafter referred to as BES) which includes any worker-year record that satisfies the inclusion criteria that $2<T_i<8$, where $T_i$ indicates the number of years during which worker i was in the sample during the sub-period. The Narrow Estimation Sample (hereafter referred to as NES) is a sub-sample of the BES in which persons report above-minimum earnings in *each year* of the relevant sub-period (i.e., $T_i = 8$). Most of the sampling practice for the decomposition literature has focused on just an NES-type sample for males. In the present paper, then, there are four separate estimation samples for each gender: BES and NES for the separate periods 1982-1989 and 1990-1997.

The numbers of records in the full LAD file and the effects of the various exclusion criteria going from the full LAD file to the final BES, and then from the BES to the NES for each of the sample years are listed in Table A1 of Beach, Finnie and Gray (2001). The most frequent exclusions

4. For instance, Moffitt and Gottschalk (1995) employ the covariance estimate to the same data set over the same interval as Gottschalk and Moffitt (1994), and obtain qualitatively similar results regarding the variance components, and the estimates that Beach, Finnie and Gray (2001) find for men with a high degree of labour force attachment are consistent with those presented in Baker and Solon (2003).

5. When compiling the LAD file, special procedures are employed in order to deal with individuals who have changed their SINs (social insurance numbers), who have multiple SINs, and other non-standard cases (see Finnie, 1997), which comprise on the order of 4 percent of the file in any given year. Full-time students are identified from tuition and education tax credit responses on T1 forms.

applied when creating the BES involve workers over age 64, the self-employed (most of whom had very low labour market earnings), and non-continuous participants in the labour market. The BES samples tend to be about twice as large as the NES samples, indicating that many of the former are non-continuous labour market participants.[6]

The first sub-period spanning the interval 1982-1989 commences near the end of the sharp 1980-82 recession and then includes much of the subsequent expansion, whereas the second period (1990-1997) includes the trough of the 1990-92 recession and some of the growth period which followed. Our results represent comparisons between two sub-periods reflecting fairly similar business cycles.[7]

The estimation samples of this paper also involve breakdowns by age crossed with gender. The four age groups are 'Entry' (age 20-24), 'Younger' (age 25-34), 'Prime' (age 25-54), and 'Older' (age 55-64). This allows us to examine separate earnings variability patterns over different phases of the life-cycle.

As reported in Beach, Finnie and Gray (2003), the descriptive statistics reveal major differences in earnings outcomes between the BES and the more conventionally analyzed NES samples. The highlights include the following. The BES median earnings levels are noticeably lower than the NES figures, and the ratio of the BES median earnings to NES earnings has declined between 1982 and 1997. Though it is not surprising that median earnings are higher for workers with continual employment, it is interesting to note that the earnings of those less attached to the labour force (i.e., the BES) have been declining relative to the group with very stable labour market profiles (i.e., the NES). This pattern likely reflects the relatively poor performance of the Canadian labour market over the early to middle part of the 1990s, which may have had a more adverse impact on labour market outcomes for the BES group, as well as a shift toward greater use of contingent and non-standard employment arrangements and worsening labour market

6. The resulting BES includes 1,069,000 observations in 1997, or 50.3% of the full LAD file in that year, while the NES includes 595,600 observations, or 55.7% of the BES sample and 26.7% of the full LAD file. The BES sample varies from 924,000 observations in 1982 to the 1,069,000 observations for 1997. The NES sample has 538,900 records for the first sub-period and 595,600 in the second sub-period. By construction, the number of individuals in the NES samples is constant for each year within these two sub-intervals.

7. The two intervals over which our variances are calculated have the attractive feature of symmetry, as they both span 8 years, and they exhaust the entire LAD sample until 1997. On the other hand, they do not reflect identical phases of the business cycle. Given that the macroeconomic conditions were somewhat different during the two time periods, it is possible that the trend effect that we attempt to discern between these two time periods may to some extent be confounded with business cycle effects. To address this possibility, we examined the robustness of our calculations of the variance to a change in the time intervals. The buffer years of 1989 and 1990 were omitted, so that the two time periods become 1982-1988 and 1991-1997. This omission generates two intervals each spanning 7 years, thus preserving the symmetry feature. Both of these time periods commence near the trough of a business cycle and end six years into an expansion phase. The resulting changes in earnings variability between the earlier and the later periods (expressed in percentage terms) are slightly larger in the shortened intervals compared to the full intervals of 1982-1989 and 1990-1997. Nevertheless, the signs and the relative magnitudes of the percentage changes over time are quite robust to the change in intervals over which the variance components are calculated. This pattern is consistent with the conjecture that there is a secular trend of increasing earnings variance over time. As the gap between the two time periods widens (from no gap between adjacent intervals of 1982-1989 and 1990-1997 to a hiatus of 2 years), the contrast between their measures of dispersion is enhanced, which suggests that the business cycle phase is not driving our primary results.

outcomes of young cohorts of workers (Beach and Finnie, 2004). Indeed, the BES samples show an absolute decline in median real earnings for all men and for each male age group, while the NES samples indicate an absolute rise in median real earnings for all men and for prime-age workers. Unsurprisingly, for both genders earnings inequality is much greater in the more heterogeneous BES samples than the corresponding NES samples. The BES results also show a sizeable increase in earnings inequality, especially in the case of men, which is in contrast to a slight decrease for the NES figures.

## 5. Variance components by region and time period

For all of our analysis, we first estimate life-cycle adjusted earnings profiles based on log-earnings regressions. The dependent variable is $y_{it}$, the log earnings for an individual in a given year, and the independent variables consist of a quartic in age for each sex for each of four estimation samples (males BES and NES, females BES and NES). Results from these earning equations (which are available from the authors) indicate a statistically significant and strong positive (negative) effect associated with age (age squared), which are consistent with the empirical literature on earnings.

After having purged out the life-cycle effects associated with the stage of the earnings career, the next step is the decomposition procedure, which is carried out for each age/sex group, time period and region. Details of the decomposition procedure are outlined in the accompanying Appendix. As these results by age and sex are presented in Beach, Finnie and Gray (2003), we make only a very brief mention of them here in order to provide some background for the decomposition exercise and subsequent regression analysis. First, the breakdown in the total variation is approximately one-third for the transitory component versus two-thirds for the permanent component, a finding consistent with the result that Gottschalk and Moffitt (1994) obtained using earlier U.S. data. Second, the significant rise in earnings variability for men is driven primarily by the permanent component. The increased volatility of workers' earnings about their life-cycle earnings profiles (i.e., earnings instability) did, however, play a secondary role in the overall increase in earnings variability for men, while for women this effect was very small or even worked to reduce overall earnings variability in the case of some age groups. Baker and Solon (2003), looking only at men with high attachment to the labour market—analogous to our NES sample—found that earnings inequality in Canada grew substantially over the 1976-1992 period and the rise in inequality stemmed from upward trends in both permanent and transitory variance components. They also found an approximate 1/3 vs 2/3 breakdown of total earnings variance between its two components and the increases in the permanent component playing the dominant role in the total variance increase over the period along with some increases in transitory earnings instability.

For the presentation of the results, we express the calculations in terms of levels as well as in terms relative to the sum of the permanent and the transitory components. The components expressed as shares are a straightforward measure of their relative importance. While the sum of the two components is exactly equal to total variance in the (rectangular) NES sample, in the event that some individuals have observations for only some of the 8 years that span both of these estimation intervals (i.e., our BES sample), the exact decomposition breaks down. In all of our calculations involving the BES, however, the discrepancy was not large in relative terms.

A word of interpretation of the decomposition results is in order. Since these results are based on *longitudinal* data, the three variance terms are different from conventional inequality or dispersion estimates calculated from cross-sectional data. The latter estimates incorporate both long-run earnings differences related to skill levels and work activity across workers as well as transitory differences associated with short-run fluctuations in earnings—all combined at a given point in time. Since the total variance calculated from longitudinal data also incorporates both of these components, it is the measure most comparable to cross-sectional estimates. The novelty of the present paper, though, lies in using longitudinal data to break out these two components. The transitory variance picks up year-to-year deviations in earnings about a life-cycle earnings trajectory and hence is an estimate of earnings *instability*. The permanent variance picks up differences across workers in the average height of their life-cycle earnings trajectories. Since the latter reflect long-run persistent factors, the permanent variance component provides an estimate of *long-run inequality* of earnings. The discussion of results will focus more on these two components.

All three variance terms in Tables 1 and 2 are higher in the BES sample than in the more homogeneous NES one, not surprisingly since the BES includes many workers with relatively low and unstable earnings patterns. But the relative importance of the permanent and transitory components remains similar in the two samples at about two-thirds for the former and one-third for the latter. All variance terms are also generally larger for women than for men, but the relative importance of the two variance components remains pretty similar for both genders.

The last three columns of Tables 1 and 2 indicate that overall earnings variability increased between 1982-1989 and 1990-1997 and the increase was largely confined to men. This has been observed in several other studies for both Canada and the United States.[8] But the greater part of this increase (especially for men) has been driven by widening long-run earnings inequality. For men, increased instability of earnings did play a secondary role in the overall earnings variance increase. For women, though, earnings instability showed substantial decreases while long-run inequality widened, though only about half as much as for men. As a result, the gap in earnings variances between women and men has noticeably declined over this period.

Regional differences in earnings variances are also apparent and will drive the macroeconomic effects examined in the next section. Overall earnings variance is markedly the highest for workers in the Atlantic region, followed by Quebec and Alberta (and British Columbia in the BES sample); it is lowest in Manitoba-Saskatchewan and Ontario (for some sub-samples). Long-run earnings inequality is most important (relative to transitory earnings instability) in Atlantic Canada, and least so in British Columbia, Ontario and Alberta. Increases in earnings variability among men over the two periods were greatest in Ontario and Quebec, which experienced quite severe recessions in the early nineties and whose manufacturing base experienced substantial restructuring and changing trade patterns. Again, it was largely increases in long-run earnings inequality which were driving the results in these regions.

8. For a recent survey and treatment of earnings inequality in Canada, see Lemieux (2002).

## 6. Net effects of time shift, age and region

We now make use of the fact that the estimating samples can be categorized into age/sex groups crossed with geographical region in order to generate a finer breakdown to which multivariate regression can be applied. This regression framework is similar to that adopted by Sharpe and Zyblock (1997). As there are four age groups (entry level, younger, prime-age and older) for each time period within each of the six regions, 48 cells are generated. For each cell, the total variance, the transitory component, and the permanent component are calculated for the four samples: BES men, BES women, NES men, and NES women. Each of these three variance terms is then expressed as the dependent variable in a linear regression function of one set of binary variables for the six regions (with Ontario serving as the omitted category) and another set for the four age groups (with prime-age workers servings as the omitted category). As there are three equations that are fitted for each of the four samples, there are a total of 12 regressions estimated.

Table 3 lists the full results for the equations modelling total variation of earnings. As might be expected with aggregated data, the values for the (adjusted) coefficient of determination are high—approximately 0.86. For both genders and in both the BES and the NES samples, the Atlantic provinces show a significantly higher net earnings variance (relative to Ontario). Smaller net positive effects are also captured for British Columbia and Alberta, and again slight negative effects occur for Manitoba and Saskatchewan.

Total earnings variance also varies with age, though more significantly for men. The age profile of total earnings variance for men is U-shaped or saucer-shaped with youngest and oldest workers experiencing the highest variances. Among women, total earnings variance generally increases with age, but the differences are generally smaller than those for men. The permanent variance component (not shown) tends to increase with age as earnings differentials generally widen over the life cycle. But the earnings instability component tends to decline with age as job mobility generally decreases as workers get older, with the notable exception of older men.

The secular increases in earnings variances observed in Tables 1 and 2 also shows up after one controls for differences across regions and age groups. Summary Table 1 collects the time-shift coefficient results for total variance (in Table 3) and its transitory and permanent components[9] between the sub-periods 1982-1989 and 1990-1997. Again, the increases are significant only for men, but they are apparent across all three variance measures and are stronger for workers with discontinuous earnings history. For both samples, the increase in the permanent component far exceeds that in the transitory component.

9. The results for the full specifications of the equations for the transitory and the permanent components are available from the authors.

**Summary Table 1: Regression estimates of net time-shift effects dependent variable: Total variance and components**

| | Men | | | Women | | |
|---|---|---|---|---|---|---|
| Time shift (later period relative to earlier period) | Total variance | Transitory variance | Permanent variance | Total variance | Transitory variance | Permanent variance |
| BES | 0.066** (0.012) | 0.020** (0.005) | 0.053** (0.01) | 0.003 (0.009) | -0.003 (0.004) | 0.007 (0.008) |
| NES | 0.040** (0.011) | 0.000 (0.004) | 0.038** (0.008) | 0.012 (0.006) | -0.001 (0.004) | 0.010 (0.006) |

Notes: N = 48; standard errors in parentheses; ** (*) denotes statistical significance at the 1% (5%) level.

## *7. Macroeconomic effects on earnings inequality and instability*

As already mentioned, the permanent variance component can be viewed as an estimate of long-run earnings inequality across workers over each of the two sub-periods. The transitory variance component is an estimate of average year-to-year variation in the earnings of workers, or earnings instability, over a given interval. It is most interesting to focus interpretation on these two elements separately, and then view the total variance effects as simply the net outcome of the effects on the two components. As Moffitt and Gottschalk (2002) point out, in the literature on earnings inequality, most estimates of "trickle-down effects" on inequality—and indeed most discussion of inequality—operate solely through total earnings data that have not been adjusted for a major source of micro variation in workers' earnings—but we now do so within the regression framework in our paper.

The next set of regressions are based on the same data structure as those just presented: a total of 12 equations are estimated consisting of 3 dependent variables (one for each variance measure) for 4 samples (male BES, male NES, female BES, female NES). In these specifications, the set of provincial binary variables is replaced by two variables reflecting the macroeconomic conditions that prevailed in each region during each of the two eight-year intervals: the average unemployment rate, and the rate of real GDP growth. The latter quantity is calculated over each interval as the ratio of the final year's real GDP to the first year's real GDP minus one, which generates the cumulative rate of growth expressed as a decimal.[10] The estimated coefficients of these indicators are identified by inter-regional variation, as well as by inter-temporal variation over the two time periods. There is, nonetheless, considerable variation in these indicators. For Canada as a whole, real GDP increased by 31.7 percent over 1982-1989 and then by only 15.8 percent over 1990-1997. The highest growth rate in the first period was experienced by Ontario (41.0 percent)[11] and in the second period by Alberta (32.8 percent). The slowest growth occurred in the first period in Manitoba and Saskatchewan (20.9 percent) and in the second in the Atlantic

10. These values observed in each province are then averaged across regions using weights by relative population sizes. The annual unemployment rate averages are then averaged over the eight-year interval.

11. All figures from Statistics Canada (2003): 105, 109.

region (9.2 percent). In terms of employment growth, Ontario led the pack over 1982-1989 at 23.6 percent, but then this fell to only 2.4 percent over 1990-1997. There are similar figures for Quebec at 18.3 and 1.7 percent, respectively. On the other hand, British Columbia experienced employment growth of 20.5 percent the first period and again 20.2 percent in the second. While unemployment rates remained high in both periods in Atlantic Canada and Quebec, they rose from averages of 7.5 to 9.1 percent between periods in Ontario, but declined from 9.3 to 7.9 percent in Alberta and from 12.4 to 9.1 percent in British Columbia. So quite a mix of patterns was experienced. Note that these regressions are not viewed as causal or structural economic relationships, but simply as capturing summary statistical relationships over the period.

## *8. Regression results with macroeconomic indicators*

The results for the regression equations including the average unemployment rate and the real GDP growth rate appear in Tables 4 (for the total variance), 5 (for permanent variance), and 6 (for transitory variance). The age and time-shift effects are similar to those already discussed. For continuous variables such as the macroeconomic indicators, sensitivity is often better represented by elasticities (evaluated at sample means) from results in Tables 4-6 and presented in Summary Table 2.

Not surprisingly, all three variance measures are more sensitive to fluctuations in the unemployment rate (a direct labour market measure) than to changes in the GDP growth rate (an output market measure). This also shows up more for men than for women, which is consistent with men being more concentrated in the primary, manufacturing, and transportation/construction sectors which are more cyclically sensitive. The macroeconomic effects on transitory earnings variance or earnings instability occur pretty much as expected from conventional labour market arguments. Good economic times (i.e., high economic growth) are associated with more stable employment patterns so that earnings instability is reduced, moreso for men than for women and moreso within the BES sample which includes more irregular or intermittent workers. Reduced unemployment rates and thus tighter labour markets also reduce earnings instability, again moreso for men than for women because of the generally more cyclical nature of the sectors in which men are more concentrated. But interestingly, this effect shows up stronger in the more homogeneous NES sample than in the BES sample. This suggests that workplace restructuring during (the early 1990s) recession applied at least as much to higher-wage jobs of workers fully attached to the labour market as to relatively low-wage jobs and those only intermittently attached to the labour market (the UR coefficients in Table 6 are essentially the same between samples for each of men and women).

**Summary Table 2: Elasticities for unemployment rates and real GDP growth rates**

| | Men | | | Women | | |
|---|---|---|---|---|---|---|
| | Total variance | Transitory variance | Permanent variance | Total variance | Transitory variance | Permanent variance |
| **Broad Estimation Sample (BES)** | | | | | | |
| UR | 0.1195* | 0.1714* | 0.0437 | 0 .1179** | 0.0382 | 0.1192** |
| GR | 0.0159 | -0.0440** | 0.0386** | 0.0262** | -0.0303* | 0.0468** |
| **Narrow Estimation Sample (NES)** | | | | | | |
| UR | 0.3221** | 0.3092** | 0.3464** | 0.2420** | 0.1009 | 0.3067** |
| GR | 0.0451** | -0.0258 | 0.0766** | 0.0550** | -0.0212 | 0.0878** |

Note: ** (*) denotes statistical significance at the 1% (5%) level. UR is an abbreviation for the unemployment rate, and GR is the measure for real growth in GDP.

The macroeconomic effects on permanent earnings variance or long-run earnings differences across workers raise some interesting questions. Gross results in Tables 1 and 2 and conventional economic theory suggest that, in periods of prosperity and economic expansion, wage differentials narrow and low-skilled lower-wage workers disproportionately benefit from tighter labour markets, so earnings inequality should attenuate, while in periods of slow growth and economic recession the opposite should happen, and that these effects should be stronger in the more heterogeneous BES sample rather than in the NES. And it is indeed true that slower growth over the 1990-1997 period is associated with increases in both permanent (and total) variance measures. But what we observe in Summary Table 2 are *positive* effects of GDP growth on permanent variance or long-run inequality across workers (as well as on total variance), and these effects are substantially larger in the NES than the BES samples and indeed slightly larger for women than for men. And all four of these estimated effects are individually, highly statistically significant. This distinctive and strong result requires explanation.

The conventional theory dating back to the 1960s and 1970s was based on the perspective that "a rising tide raises all boats" combined with working out the cyclical implications of specific human capital and a standard supply-demand analysis of wage differentials over the business cycle. But the present results, especially for the 1990s, suggest that other things are going on as well, which may be having a dominating effect. This alternative or new paradigm is based on the more recent phenomena of economic restructuring and changing demographics alluded to in the opening paragraph of this paper. High growth provinces such as Ontario and British Columbia (and to some extent Alberta) have attracted substantial in-migration of young workers (whose earnings levels tend to be relatively low and have indeed fallen significantly compared to the previous generation of youth) and immigrants (whose earnings have also fallen significantly relative to non-immigrants over the last twenty years). Indeed, overall levels of immigration shifted up in the mid-to-later 1980s and continued at a much higher level in the 1990s than in the 1960s and 1970s. The 1990s saw a marked decrease in the rate of growth—indeed a downsizing—of the public sector (where employment has traditionally been more stable and wage differentials narrower than in the private sector), a decline in the overall unionization rate in Canada's private sector, and steps toward deregulation in selective industries such as airlines and telecommunications.

More generally, two phenomena have generated a huge literature in economics over the last decade as leading explanations for the observed growing inequality in workers' earnings—growing globalization, out-sourcing, and international trade; and the advent of skill-biased technological change based on chip-based recent information technology—the two so-called "I.T." hypotheses (Katz and Autor, 1999; Beach, 2004). These have both been argued to have huge effects on economic restructuring and reorganization of the workplace. The Canada-U.S. Free Trade Agreement took effect in 1989 and the North American Free Trade Agreement took effect in January 1994. The results, Courchene and Telmer (1998) and others have argued, have been a massive reorganization of Canadian trade patterns away from an east-west axis to a north-south axis and a corresponding increase in the competitiveness of output markets and hence increased cost-awareness and restructuring of workplace arrangements. New information technologies combined with cost-containment pressures have also resulted in seeking new ways to reorganize workplace operations and restructure employment relationships through out-sourcing and more non-standard work arrangements (Bartel *et al.*, 2005). If these broad changes have generally been implemented in the more high-growth and more manufacturing-oriented regions of the country, this would at least explain some of the widening earnings inequality seen in the data. Recall, for example, the big increases in Ontario and to a lesser extent Quebec and Alberta in permanent variance in Tables 1 and 2, higher growth regions where we might expect the effects to be most evident. Recall also the positive coefficients of GR on permanent variance in Summary Table 2. Finally, these pressures might help explain why the effects are operating even more strongly in the NES sample than in the BES sample which includes more intermittent workers. Adjustment to the "new economy" paradigm is likely happening faster in the more high-growth and more manufacturing-oriented provinces and this compound of growth and restructuring is what is being picked up by the GR effects in Summary Table 2. If so, this calls for a general re-examination of the arguments for (and channels through which the arguments operate) macroeconomic effects on earnings inequality in the transition to the "new economy".

## 9. Simulation exercise of an economic recovery

The discussion of the regression results pertains to the ceteris paribus influences of the two macroeconomic indicators. Growth in real GDP and labour market tightness, however, do not vary independently; instead there is a strong positive correlation between them. It thus makes sense to examine the unemployment rate and the GDP growth rate effects *jointly* through a simulation exercise incorporating the above macroeconomic effects. For convenience, we examine a scenario of economic recovery conditions—'good times' in popular jargon—characterized by a one standard deviation increase in the real GDP growth rate (+0.32) combined with a one standard deviation reduction in the unemployment rate (-2.4). As discussed above, the latter effect reduces all variance components, while the former has opposing effects on the long-run inequality and the earnings instability components. The resulting percentage changes in the variance components (as computed from the regression coefficients in Tables 4-6) appear in Table 7, and the signs of the effects are presented in Summary Table 3.

**Summary Table 3: Macroeconomic prosperity effects on earnings: Total variance and components**

| Sub-sample | Variance component | Independent effect of unemployment rate | Independent effect of real GDP growth | Joint effect of macro prosperity | Total effect of macro prosperity on total variation |
|---|---|---|---|---|---|
| NES males | permanent | positive | positive | negative | negative |
| | transitory | positive | negative | negative | |
| BES males | permanent | positive | positive | positive | negative |
| | transitory | positive | negative | negative | |
| NES females | permanent | positive | positive | positive | negative |
| | transitory | positive | negative | negative | |
| BES females | permanent | positive | positive | positive | negative |
| | transitory | positive | negative | negative | |

Several results are evident from this simulation exercise. First, with the exception of NES men, long-run inequality of earnings (i.e., the permanent component) still increases with economic prosperity because of the dominance of the GDP growth effect. Second, in contrast, the instability of earnings (i.e., the transitory component) is reduced with economic prosperity because of the strong unemployment rate effect combined with the negative growth effect on instability. The joint macroeconomic prosperity effect is very much stronger on the instability of earnings than on long-run inequality; this holds for both genders and both the NES and the BES samples. Third, given a climate of macroeconomic prosperity, since the reduction in earnings instability is so strong, it dominates the increase in long-run inequality of earnings so as to generate a net reduction of total variance with greater economic prosperity despite the fact that the share of the permanent component within the total variance is much greater. In other words, favourable macroeconomic performance tends to reduce the overall variation of earnings, despite the opposing effects on its two components; it also reduces the ratio of transitory to permanent variance and increases the ratio of permanent to total variance.

## *10. Conclusions*

This study has examined earnings variability of workers in Canada by applying a variance decomposition approach to the Longitudinal Administrative Database (LAD) file over the 1982-1997 period. The total variation in earnings between individuals and over time is broken into two components: the persistent differences in earnings across individuals which remain after taking into account the general shape of age-earnings profiles (i.e., permanent or long-run earnings inequality), and the year-to-year variation in earnings around each individual's age-adjusted earnings profile (i.e., earnings instability). The contributions of this paper are (i) to examine the variability of workers' earnings in Canada over the 1982-1997 period and how earnings variability has varied in terms of the macroeconomic indicators, the unemployment rate and the real GDP growth rate over the period; and (ii) to provide benchmark results on the earnings variability experience of women as well as men and for a broader sample of labour market participants beyond those regularly employed.

Several major results have been found. First, simple inspection as well as regression analysis indicate an increase in overall earnings variability between 1982-1989 and 1990-1997 that was largely confined to men. This has been observed in several other studies for both Canada and the United States. But the greater part of this increase in earnings variability (especially for men) was driven by widening long-run earnings inequality. Among the broader sample of men in the labour market, increases in long-run earnings inequality accounted for 59 to 134 percent of the higher earnings variability, while in the sample of regularly employed men, they accounted for virtually all of the increases. Increased instability of workers' earnings did play a secondary role in the overall increase in men's earnings variability, while for women this change was very small or, in the case of some age groups, worked to reduce women's overall earnings variability. As a result, the gap in earnings variances between women (who experience the higher variances) and men has noticeably declined.

Second, both unemployment rates and real GDP growth rates have statistically significant effects on total earnings variability and its two components, with the unemployment rate having much stronger effects in terms of elasticities. The pattern of unemployment rate and GDP growth rate effects on earnings instability are very much consistent with conventional cyclical labour market arguments where unemployment and earnings instability increase in recessions and periods of slow growth and then shift down again in ensuing expansions and tighter labour markets. The estimated growth rate effect on long-run earnings inequality, however, does not fit conventional arguments. It is, rather, more consistent with an alternative paradigm of more recent economic growth being associated with economic restructuring and workplace reorganization in response to changing trade patterns and information-based technological change that are widening earnings inequality in the labour market. The positive growth rate effect is also stronger among regularly employed workers rather than those more marginally attached to the workforce.

Third, when unemployment rate and GDP growth rate effects are considered jointly in a simulation analysis, macroeconomic improvement (through higher growth and reduced unemployment rates) is found to reduce the overall variability of earnings as the reduction in earnings instability outweighs the general widening of long-run earnings inequality across workers.

Appendix

**Variance decomposition procedure**

The common starting point is the variance of a worker's (log) earnings over time. Consider the following variables:

$y_{it}$ = log earnings for person i in year t
$T_i$ = number of years of earnings data observed for person i, i = 1, ..., N
and $K = \sum_{i=1}^{N} N \cdot \bar{T}$
where an over-bar indicates a sample average.

$\bar{T}$ is thus the average number of years of earnings data for the sample of N workers. It follows that

$$\bar{y}_i = \frac{1}{T_i} \sum_{t=1}^{T_i} y_{it}$$

is the average (log) earnings over the earnings-reported years of worker i, and that:

$$\bar{\bar{y}} = \frac{1}{K} \sum_{i=1}^{N} \sum_{t=1}^{T_i} y_{it}$$

is the global, or overall, average level of (log) earnings across all workers in the data set. The measure of total earnings variation used is then the unbiased estimate for the global or total variance:

$$\text{Var}_{\text{Total}} = \frac{1}{(K-1)} \sum_{i=1}^{N} \sum_{t=1}^{T_i} \left( y_{it} - \bar{\bar{y}} \right)^2 \qquad (1)$$

This expression reflects both variation in earnings across time for individual workers and variation in earnings between workers at a given point in time. One can commence the decomposition process by defining a measure of transitory variance or temporary earnings instability as:

$$\text{Var}_{\text{Transitory}} = \underbrace{avg}_{i} \underbrace{\left[ \text{var}\left( y_{it} \right) \right]}_{t} = \frac{1}{N} \sum_{i=1}^{N} \left[ \left( \frac{1}{T_i - 1} \right) \sum_{t=1}^{T_i} \left( y_{it} - \bar{y}_i \right)^2 \right] = \hat{\sigma}_{tr}^2 \qquad (2)$$

The above quantity represents the average of the intertemporal variance of (log) earnings across workers. The measure appearing in square brackets is an (unbiased) estimate of the year-to-year volatility or instability of the (log) earnings of worker i.

The next step is to define a measure of persistent or permanent earnings variance as:

$$\text{Var}_{\text{Permament}} = \left( \frac{1}{N-1} \right) \sum_{i=1}^{N} \left( \bar{y}_i - \bar{\bar{y}} \right)^2 - \frac{\hat{\sigma}_{tr}^2}{\bar{T}} . \qquad (3)$$

Although this entire expression (3) is less intuitive than (2), the term on the left essentially captures the variation in earnings (that has already been averaged over time for each worker) across all workers in the sample. It can then be shown that the total variance equals the sum of the transitory variance and the permanent variance, thus providing a convenient decomposition of total variance. Following the same notation as above, we have:

$$\text{Var}_{\text{Total}} = \text{Var}_{\text{Transitory}} + \text{Var}_{\text{Permanent}} \qquad (4)$$

provided that $T_i = T$ for all i, meaning that there is the same number of time-series observations for all individuals in the sample.

In the application of formulas (1), (2), and (3), $y_{it}$ is replaced by the life-cycle adjusted (log) earnings which is generated as:

$$ya_{it} \,/\, \ln Y_{it} - \text{estimated } (\ln Y_{it}), \qquad (5)$$

where $\ln Y_{it}$ is the actual reported (log) earnings, and estimated ($\ln Y_{it}$) is predicted log-earnings from an OLS regression equation of log-earnings on a quartic in age; $ya_{it}$ is thus generated as log earnings net of effects associated with age. The measure in square brackets in (2), therefore, picks up the life-cycle adjusted variance in (log) earnings, or the variation in (log) earnings about the worker's life-cycle earnings trajectory. The entire expression (2) captures the average across all workers of this earnings variability. Similarly, formula (3) essentially captures differences in the levels of life-cycle log-earnings trajectories across workers. Since there is only one life-cycle (log) earnings regression estimated across all workers (by gender) in our sample, high-skilled workers with high earnings trajectories will have a series of large positive $ya_{it}$ values, and low-skilled workers with low earnings trajectories will have a series of large negative $ya_{it}$ values. The transitory variance captures the volatility of earnings about individuals' life-cycle trajectories, while the permanent variance captures the more persistent and enduring variation in log-earnings between workers of different life-cycle profile levels (i.e., between workers of different skill levels).

In the case that $T_i$ is not the same for all workers in the sample, the decomposition in (4) is no longer exact but is only approximate. This caveat, which applies in the cases of unbalanced panels, is relevant for the distinction between the NES and the BES samples in the paper.

**Table 1: Decomposition of earnings variability, 1982–1989 vs 1990–1997, by region for men**

| Sample | 1982–1989 | | | 1990–1997 | | | Pctg. change between periods | | |
|---|---|---|---|---|---|---|---|---|---|
| | Total variance | Trans. variance | Perm. variance | Total variance | Trans. variance | Perm. variance | Total variance | Trans. variance | Perm. variance |
| BES: | | | | | | | | | |
| Atlantic | 0.6911 | 0.2310 | 0.5458 | 0.7246 | 0.2540 | 0.5785 | 4.85 | 9.96 | 5.99 |
| Quebec | 0.5443 | 0.2320 | 0.4213 | 0.6341 | 0.2638 | 0.5056 | 16.50 | 13.71 | 20.01 |
| Ontario | 0.5394 | 0.2376 | 0.4279 | 0.6403 | 0.2808 | 0.5158 | 18.71 | 18.18 | 20.54 |
| Man./Sask. | 0.5741 | 0.2255 | 0.4819 | 0.6037 | 0.2229 | 0.5233 | 5.16 | - 1.15 | 8.59 |
| Alberta | 0.6133 | 0.2747 | 0.4540 | 0.6508 | 0.2568 | 0.5242 | 6.11 | - 6.52 | 15.46 |
| B.C. | 0.6104 | 0.2806 | 0.4654 | 0.6655 | 0.2795 | 0.5473 | 9.03 | - 0.04 | 17.60 |
| NES: | | | | | | | | | |
| Atlantic | 0.4890 | 0.1266 | 0.3624 | 0.5092 | 0.1284 | 0.3808 | 4.13 | 1.42 | 5.08 |
| Quebec | 0.3440 | 0.1154 | 0.2286 | 0.3948 | 0.1177 | 0.2771 | 14.77 | 1.99 | 21.22 |
| Ontario | 0.3121 | 0.1117 | 0.2004 | 0.3578 | 0.1111 | 0.2467 | 14.64 | - 0.54 | 23.10 |
| Man./Sask. | 0.3150 | 0.1001 | 0.2150 | 0.3562 | 0.0973 | 0.2589 | 13.08 | - 2.80 | 20.42 |
| Alberta | 0.3690 | 0.1358 | 0.2332 | 0.3932 | 0.1155 | 0.2776 | 6.56 | -14.95 | 19.04 |
| B.C. | 0.3394 | 0.1307 | 0.2087 | 0.3530 | 0.1136 | 0.2394 | 4.01 | -13.08 | 14.71 |

Note: BES = Broad Estimation Sample, NES = Narrow Estimation Sample.

**Table 2: Decomposition of earnings variability, 1982–1989 vs 1990–1997, by region for women**

| Sample | 1982–1989 | | | 1990–1997 | | | Pctg. change between periods | | |
|---|---|---|---|---|---|---|---|---|---|
| | Total variance | Trans. variance | Perm. variance | Total variance | Trans. variance | Perm. variance | Total variance | Trans. variance | Perm. variance |
| BES: | | | | | | | | | |
| Atlantic | 0.8344 | 0.2844 | 0.6321 | 0.8076 | 0.2585 | 0.6405 | - 3.21 | - 9.11 | 1.33 |
| Quebec | 0.6959 | 0.2866 | 0.5212 | 0.7023 | 0.2670 | 0.5550 | 0.92 | - 6.84 | 6.49 |
| Ontario | 0.6967 | 0.2980 | 0.5146 | 0.7169 | 0.2858 | 0.5672 | 2.90 | - 4.09 | 10.22 |
| Man./Sask. | 0.6954 | 0.2858 | 0.5241 | 0.6686 | 0.2548 | 0.5364 | - 3.85 | -10.85 | 2.35 |
| Alberta | 0.7223 | 0.3311 | 0.5029 | 0.7292 | 0.3006 | 0.5479 | 0.96 | - 9.21 | 8.95 |
| B.C. | 0.7435 | 0.3305 | 0.5279 | 0.7455 | 0.3062 | 0.5697 | 0.27 | - 7.35 | 7.92 |
| NES: | | | | | | | | | |
| Atlantic | 0.6063 | 0.1501 | 0.4562 | 0.5824 | 0.1348 | 0.4477 | -3.94 | -10.19 | - 1.86 |
| Quebec | 0.4397 | 0.1457 | 0.2939 | 0.4579 | 0.1321 | 0.3257 | 4.14 | - 9.35 | 10.82 |
| Ontario | 0.4431 | 0.1560 | 0.2871 | 0.4480 | 0.1318 | 0.3162 | 1.11 | -15.51 | 10.14 |
| Man./Sask. | 0.4370 | 0.1536 | 0.2834 | 0.4247 | 0.1255 | 0.2990 | -2.81 | -18.29 | 5.50 |
| Alberta | 0.4481 | 0.1770 | 0.2711 | 0.4634 | 0.1532 | 0.3101 | 3.41 | -15.45 | 14.39 |
| B.C. | 0.4510 | 0.1707 | 0.2803 | 0.4588 | 0.1539 | 0.3050 | 1.73 | - 9.84 | 8.81 |

Note: BES = Broad Estimation Sample, NES = Narrow Estimation Sample.

**Table 3: Regression analysis of the <u>total</u> variance across alternative samples: Net effect of time shift, age group and region**

| | Men | | Women | |
|---|---|---|---|---|
| Independent variables | BES | NES | BES | NES |
| Time shift (later period relative to earlier period) | 0.066** (0.012) | 0.040** (0.011) | 0.003 (0.009) | 0.012 (0.006) |
| Entry level | 0.052** (0.017) | 0.118** (0.016) | -0.104** (0.013) | -0.015 (0.009) |
| Younger | 0.002 (0.017) | -0.005 (0.016) | 0.021 (0.013) | 0.006 (0.009) |
| Older | 0.204** (0.017) | 0.173** (0.016) | 0.036* (0.013) | 0.047** (0.009) |
| Atlantic Provinces | 0.084** (0.021) | 0.147** (0.019) | 0.094** (0.016) | 0.136** (0.011) |
| Quebec | -0.017 (0.021) | 0.027 (0.019) | -0.011 (0.016) | 0.009 (0.011) |
| Manitoba and Saskatchewan | -0.013 (0.021) | -0.003 (0.019) | -0.030* (0.016) | -0.020* (0.011) |
| Alberta | 0.030 (0.021) | 0.032 (0.019) | 0.013 (0.016) | 0.011 (0.011) |
| B.C. | 0.046* (0.021) | 0.016 (0.019) | 0.033* (0.016) | 0.016 (0.011) |
| Constant | 0.540** (0.019) | 0.303** (0.017) | 0.715** (0.014) | 0.436** (0.01) |
| $R^2$ (adjusted) | 0.84 | 0.86 | 0.86 | 0.86 |
| Standard error | 0.043 | 0.038 | 0.031 | 0.022 |

Notes: N = 48; the omitted category for the regions is Ontario; the omitted category for the age groups is prime age; standard errors in parentheses; **(*) denotes statistical significance at the 1% (5%) level.

**Table 4: Regression analysis of the <u>total</u> variance across alternative samples: Net effect of time shift, age group and macroeconomic indicators**

| | Men | | Women | |
|---|---|---|---|---|
| Independent variables | BES | NES | BES | NES |
| Time shift (later period relative to earlier period) | 0.075**<br>(0.015) | 0.057**<br>(0.013) | 0.018<br>(0.01) | 0.032**<br>(0.008) |
| Entry level | 0.052*<br>(0.02) | 0.119**<br>(0.017) | -0.104**<br>(0.015) | -0.015<br>(0.011) |
| Younger | 0.002<br>(0.02) | -0.005<br>(0.017) | 0.021<br>(0.015) | 0.006<br>(0.011) |
| Older | 0.204**<br>(0.02) | 0.173**<br>(0.017) | 0.036*<br>(0.015) | 0.047**<br>(0.011) |
| Unemployment rate | 0.008*<br>(0.003)<br>[0.119] | 0.013**<br>(0.003)<br>[0.322] | 0.008**<br>(0.002)<br>[0.118] | 0.011**<br>(0.002)<br>[0.242] |
| Real GDP growth | 0.036<br>(0.027)<br>[0.016] | 0.068**<br>(0.023)<br>[0.045] | 0.066**<br>(0.02)<br>[0.026] | 0.091**<br>(0.015)<br>[0.055] |
| Constant | 0.470**<br>(0.035) | 0.172**<br>(0.031) | 0.620**<br>(0.026) | 0.310**<br>(0.02) |
| $R^2$ (adjusted)<br>Standard error<br>Y-bar | 0.78<br>0.049<br>0.66 | 0.82<br>0.043<br>0.43 | 0.76<br>0.036<br>0.72 | 0.79<br>0.027<br>0.48 |

Notes: N = 48; elasticities at means reported for macroeconomic variables in square brackets; the omitted category for the age groups is prime age; standard errors in parentheses; **(*) denotes statistical significance at the 1% (5%) level.

**Table 5: Regression analysis of the permanent variance across alternative samples: Net effect of time shift, age group and macroeconomic indicators**

| | Men | | Women | |
|---|---|---|---|---|
| Independent variables | BES | NES | BES | NES |
| Time shift (later period relative to earlier period) | 0.066** (0.012) | 0.056** (0.01) | 0.025* (0.009) | 0.032** (0.007) |
| Entry level | -0.120** (0.016) | 0.022 (0.014) | -0.246** (0.012) | -0.083** (0.01) |
| Younger | -0.061** (0.016) | -0.027 (0.014) | -0.067** (0.012) | -0.033** (0.01) |
| Older | 0.072** (0.016) | 0.108** (0.014) | -0.003 (0.012) | 0.043** (0.01) |
| Unemployment rate | 0.002 (0.003) [0.044] | 0.010** (0.024) [0.346] | 0.006** (0.002) [0.119] | 0.010** (0.002) [0.307] |
| Real GDP growth | 0.066** (0.021) [0.039] | 0.080** (0.018) [0.077] | 0.087** (0.016) [0.047] | 0.103** (0.013) [0.088] |
| Constant | 0.444** (0.028) | 0.119** (0.025) | 0.510** (0.022) | 0.206** (0.017) |
| $R^2$ (adjusted) | 0.81 | 0.80 | 0.93 | 0.89 |
| Standard error | 0.038 | 0.034 | 0.03 | 0.023 |
| Y-bar | 0.49 | 0.3 | 0.53 | 0.34 |

Notes: N = 48; elasticities at means reported for macroeconomic variables in square brackets; the omitted category for the age groups is prime age; standard errors in parentheses; **(*) denotes statistical significance at the 1% (5%) level.

**Table 6: Regression analysis of the transitory variance across alternative samples: Net effect of time shift, age group and macroeconomic indicators**

| | Men | | Women | |
|---|---|---|---|---|
| Independent variables | BES | NES | BES | NES |
| Time shift (later period relative to earlier period) | 0.015* (0.007) | 0.000 (0.004) | -0.007 (0.006) | -0.002 (0.004) |
| Entry level | 0.090** (0.009) | 0.100** (0.006) | 0.059** (0.008) | 0.067** (0.006) |
| Younger | 0.029** (0.009) | 0.022** (0.006) | 0.056** (0.008) | 0.050** (0.006) |
| Older | 0.109** (0.009) | 0.058** (0.006) | 0.005 (0.008) | 0.006 (0.006) |
| Unemployment rate | 0.004* (0.002) [0.171] | 0.004** (0.001) [0.309] | 0.001 (0.001) [0.038] | 0.001 (0.001) [0.101] |
| Real GDP growth | -0.037** (0.012) [-0.044] | -0.012 (0.008) [-0.026] | -0.027* (0.012) [-0.030] | -0.010 (0.008) [-0.021] |
| Constant | 0.147** (0.017) | 0.050** (0.01) | 0.227** (0.015) | 0.100** (0.01) |
| $R^2$ (adjusted) | 0.81 | 0.88 | 0.63 | 0.80 |
| Standard error | 0.023 | 0.014 | 0.021 | 0.014 |
| Y-bar | 0.24 | 0.13 | 0.26 | 0.14 |

Notes: N = 48; elasticities at means for macroeconomic variables reported in square brackets; the omitted category for the age groups is prime age; standard errors in parentheses; **(*) denotes statistical significance at the 1% (5%) level.

**Table 7: Macroeconomic prosperity effects on earnings variance and components (in percentages)**

| | Men | | | Women | | |
|---|---|---|---|---|---|---|
| | Total variance | Transitory variance | Permanent variance | Total variance | Transitory variance | Permanent variance |
| BES | -1.19 | -8.45 | 2.88 | -0.11 | -3.95 | 1.94 |
| NES | -2.96 | -9.83 | -0.36 | -0.10 | -4.50 | 1.70 |

Note: Percentage change figures are calculated from coefficients in Tables 4-6, then divided by the sample means of the dependent variables and multiplied by 100.

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